# The Increasing Use of Remote Sensing Data in Studying the Climatological Impacts on Public Health

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## Abstract

One of the more fortunate outcomes of the capture and transformation of remote sensing data into applied information is their usefulness and impacts to better understanding climatological impacts on public health. Today, with petabytes of remote sensing data providing global coverage of climatological parameters, public health research and policy decision makers have an unprecedented (and growing) data record that relates the effects of climatic parameters, such as rainfall, heat, soil moisture, etc. to incidences and spread of disease, as well as predictive modeling. In addition, tools and services that specifically serve public health researchers and respondents have grown in response to needs of the these information users.

## Motivation

Our goal is to provide a (strong) flavor of the data and information services available to public health research and decision making; to invoke new ways of thinking about how public health work can be accomplished; and to stimulate new ideas on how information services can be further utilized.

## Conclusions

•Satellite remote sensing data and services hold great promise for alleviating limitations of monitor-based environmental data collection
•Obstacles such as uncertainties in methodology, data accessibility (for epidemiologists) and data quality are being addressed
•Numerous community efforts are addressing these issues
•A further increase in health research and modeling nurtured by more satellite products, reduced uncertainties, and user-oriented data services are on the horizon

## NASA Funded Systems Developed to Facilitate Specific Public Health Decision and Public Support Services

| Project | PI | Remote Sensing Datasets Used |
|---|---|---|
| ***Vector Borne Disease:*** | | |
| Predicting Zoonotic Hemorrhagic Fever Events in Sub-Saharan Africa using NASA Earth Science Data for DoD - Global Emerging Infections Surveillance and Response System | Jorge Pinzon | MODIS (NDVI, temperature), TRMM/GPCP (precipitation), SRTM (topography) |
| Development of a Detection and Early Warning System for Malaria Risk in the Amazon | Benjamin Zaitchik | TRMM (prcipitation), MODIS/Landsat (land cover type), AMSR-E (soil moisture), GRACE (terrestrial water storage), MODIS/landsat (vegetation fraction, LAI), SRTM (topography) |
| SERVIR Africa | Daniel Irwin | TRMM/GPCP (precipitation), MODIS, SRTM (topography), AMSR-E |
| Investigating the Potential Range, Expansion of the Vector Mosquito Aedes aegypti in Mexico with NASA Earth Science Remote Sensing Results | Sue Estes | MODIS (NDVI, LST, LCLU), AMSR-E (soil moisture), SRTM (topography),CMORPH |
| Enhanced Forecasting of Mosquito-Borne Disease Outbreaks Using AMSR-E | Michael Wimberly | AMSR-E (soil moisture), MODIS, TRMM |
| Modeling Global Influenza Risks using NASA Data | Richard Kiang | TRMM (precipitation), MODIS (LST) |
| Avian Influenza Risk Prediction in Southeast Asia and Early Warning of Pandemic Influenza | Richard Kiang | TRMM (precipitation), MODIS (LST) |
| Integrating Earth observations and satellite telemetry of wild birds for decision support system of avian influenza | Xiangming Xiao | MODIS (surface reflectance) |
| Application of NASA Data to Develop an Influenza Forecasting System | Katia Charland | from ECOCAST holdings |
| ***Water Borne Disease:*** | | |
| Service Monitoring and Forecasting Cyanobacterial Blooms for Public Health Protection and Response | Richard Stumpf | MODIS (temperature, ocean color) |
| Feasibility Study of Satellite-Assisted Detection and Forecasting of Oyster Norovirus Outbreak | Zhiqiang Deng | MODIS (ocean color) |
| Influence of Land-Use and Precipitation on Regional Hydrology and Public Health | Charles Tilburg | TRMM (precipitation) |
| ***Air Pollution Related Disease:*** | | |
| Enhancing Environmental Public Health, Tracking with Satellite-Driven Particle Exposure Modeling and Epidemiology | Yang Liu | MODIS (aerosol), GOES (aerosol/smoke), MISR (aerosol), OMI (aerosol index) |
| Integration of Airborne Dust Prediction Systems and Vegetation Phenology to Track Pollen for Asthma Alerts in Public Health Decision Support Systems | Jeffrey Luvall | MODIS Direct Broadcast (NDVI) |
| Linking NASA Environmental Data with a National Public Health Cohort Study to Enhance Public Health Decision Making | Leslie McClure | MODIS (temperature),NARR (solar irradiance, temperature, humidity) |
| Adding NASA Earth Science Results to EPHTN via the NM/EPHT System | Stanley Morain | MODIS (AOD, land cover), CALIPSO (aerosol), SRTM (topography) |
| Using NASA Satellite Aerosol Optical Depth Data to Create Representative PM2.5 Fields for Use in Human Health and Epidemiology Studies in Support of State and National Environmental Public Health Tracking Programs | Amy Huff | MODIS (AOD) |

| | |
|---|---|
| AOD - aerosol optical depth | LST - land surface temperature |
| AMSR-E - Advanced Microwave Scanning Radiometer for EOS | MISR - Multi-angle Imaging Spectro-Radiometer |
| CALIPSO - Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observation | MODIS - Moderate Resolution Imagig Spectroradiometer |
| CMORPH - Climate Prediction Center Morphing Technique | NARR - North American Regional Reanalysis |
| GOES - Geostationary Operational Environmental Satellite | NDVI - Normalized Difference Vegetation Index |
| GPCP - Global Precipitation Climatology Project | OMI - Ozone Monitoring Instrument |
| GRACE - Gravity Recovery and Climate Experiment | SRTM - Shuttle Radar Topography Mission |
| LAI - leaf area index | TRMM - Tropical Rainfall Measuring Mission |
| LCLU - Land cover land use | |

## Remote Sensing Data and Information Services Available for Public Health Studies and Decision Making

(NASA Projects)

### Health-related Data and Services from the NASA Socioeconomic Data and Applications Center (SEDAC)

Meredith L. Golden

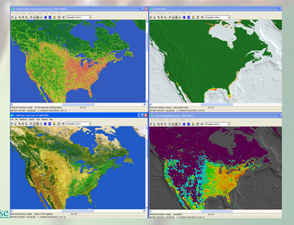
SEDAC is a NASA Earth Science Data Center specializing in data related to human interactions in the environment, and in particular on demographic and socioeconomic data that can be integrated with remote sensing data


SEDAC Interactive Map Client
http://sedac.ciesin.columbia.edu/maps/client

SEDAC Population Estimation Service
http://sedac.ciesin.columbia.edu/gpw/wps.jsp


SEDAC Map Gallery
http://sedac.ciesin.columbia.edu/maps/gallery/browse

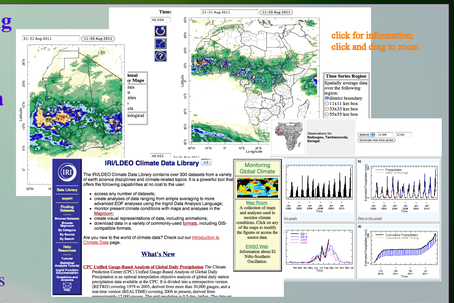
*TerraViva! SEDAC: Standalone data and viewer*
http://sedac.ciesin.columbia.edu/terraVivaUserWeb/



### The Use of Remote Sensing Data for Monitoring Rainfall, Vegetation and Water Bodies for Malaria Surveillance

Pietro Ceccato

Monitoring variations in environmental conditions such as rainfall and vegetation helps decision-makers to assess the risk levels of malaria epidemics

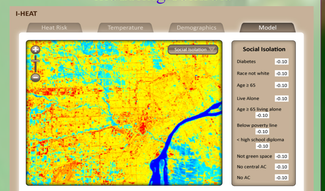



From: http://iridl.ldeo.columbia.edu/maproom/.Health/.Regional/.Africa/.Malaria/.MEWS/

### Internet-based Heat Evaluation and Assessment Tool (I-HEAT)

Susan Maxwell

I-HEAT interface showing a heat-risk map of Detroit, Michigan and modeling controls




### The Feasibility of Interoperable Multi-resolution Dust Modeling for Accelerated Forecast Availability

Karl Benedict

Information technology study analyzing the feasibility of developing dust forecasting system with improved system performance and utility:

- Timeliness to create forecast products after event has been identified
- Spatial resolution of the forecast products relative to the preferred analytic and alert units
- Utility of the forecast products – that they are in form usable by public health system users

Conclusions:

- Demonstrated efficient transfer of remote sensing data
- Alternate data transfer protocols are feasible
- Simplified parallel execution has significant potential

## Remote Sensing Data and Information Services at the Goddard Earth Science Data and Information Services Center (GES DISC) Related to Public Health Research

Steven Kempler

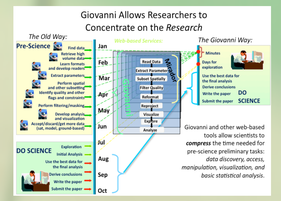
GES DISC Data Search and Access Services

Mirador
http://mirador.gsfc.nasa.gov/

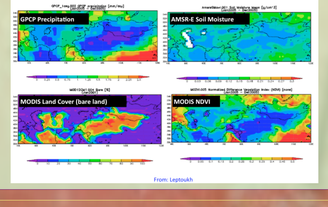
GES DISC is a NASA Earth Science Data Center specializing in servicing atmospheric, hydrologic, and precipitation remote sensing, and remote sensing based assimilated data useful for public health research, modeling, surveillance, and decision support systems

Choose:
Keyword search,
Time, Location…
or Project…
or Science Area

*Select location, time, measurement… and visualization*




Giovanni and other web-based tools allow scientists to *compress* the time needed for pre-science preliminary tasks: *data discovery, access, manipulation, visualization, and basic statistical analysis.*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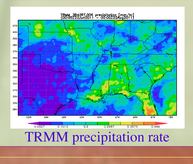
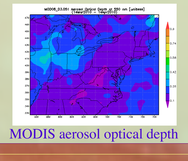
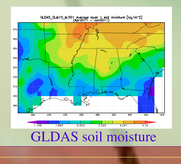


TRMM precipitation rate



MODIS aerosol optical depth



GLDAS soil moisture

| NASA's Earth Science Data Centers | Discipline |
|---|---|
| Alaska Satellite Facility SAR Data Center (ASF SDC)<br>website: http://www.asf.alaska.edu | • Synthetic Aperture Radar (SAR)<br>• Sea Ice<br>• Polar Processes<br>• Geophysics |
| Crustal Dynamics Data Information System (CDDIS)<br>website: http://cddis.gsfc.nasa.gov/ | • Space Geodesy |
| Global Hydrology Resource Center (GHRC)<br>website: http://ghrc.msfc.nasa.gov/ | • Hydrologic Cycle<br>• Severe Weather Interactions<br>• Lightning<br>• Atmospheric Convection |
| Goddard Earth Sciences Data and Information Services Center (GES DISC)<br>website: http://disc.sci.gsfc.nasa.gov/ | • Global Precipitation<br>• Solar Irradiance<br>• Atmospheric Composition<br>• Atmospheric Dynamics<br>• Global Modeling |
| Land Processes (LP) DAAC<br>website: https://lpdaac.usgs.gov/ | • Surface Reflectance<br>• Land Cover<br>• Vegetation Indices |
| Level 1 Atmosphere Archive and Distribution System (MODAPS LAADS)<br>website: http://ladsweb.nascom.nasa.gov/ | • Radiance<br>• Atmosphere |
| NASA Langley Research Center Atmospheric Science Data Center (LaRC ASDC)<br>website: http://eosweb.larc.nasa.gov/ | • Radiation Budget<br>• Clouds<br>• Aerosols<br>• Tropospheric Chemistry |
| National Snow and Ice Data Center (NSIDC) DAAC<br>website: http://nsidc.org/ | • Snow<br>• Ice<br>• Cryosphere<br>• Climate |
| Oak Ridge National Laboratory (ORNL) DAAC<br>website: http://daac.ornl.gov/ | • Biogeochemical Dynamics<br>• Ecological Data<br>• Environmental Processes |
| Ocean Biology Processing Group (OBPG)<br>website: http://oceancolor.gsfc.nasa.gov/ | • Ocean Biology<br>• Ocean Color<br>• Biogeochemistry<br>• Sea Surface Temperature |
| Physical Oceanography (PO) DAAC<br>website: http://podaac.jpl.nasa.gov/ | • Sea Surface Temperature<br>• Ocean Winds<br>• Circulation and Currents<br>• Topography and Gravity |
| Socioeconomic Data and Applications Data Center (SEDAC)<br>website: http://sedac.ciesin.columbia.edu/ | • Human Interactions<br>• Land Use<br>• Environmental Sustainability<br>• Geospatial Data<br>• Multilateral Environmental Agreements |